JP7-248507

(19) Japanese Patent Office (JP)

(12) Laid-Open Disclosure Public Patent Bulletin

(11) Patent Application Laid-Open Disclosure No.: Hei 7-248507

(43) Publication Date: September 26, 1995

(51) Int. Cl.[6]	Domestic Classification Symbol	FI
G02F 1/136	500	
1/1333	505	
1/1335	500	

Technology Description Section

Request for Examination: Not Made

Number of Claims: 4 OL (4 Pages in Total)

(21) Patent Application No.: Hei 6-39761

(22) Patent Application Date: March 10, 1994

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(54) [Title of the Invention]

LIQUID CRYSTAL DISPLAY DEVICE

(57) [Abstract]

[Problem]

An opening allowing for light transmittance is enlarged and alignment for bonding substrates to each other made easier in an active matrix liquid crystal display device.

[Structure]

A liquid crystal display device comprising a structure in which electrode wiring lines led out from a source 5 and a drain 7 of a thin film transistor 4 formed on a first substrate 9 are laminated to form a two-layered electrode wiring line, a light shielding film 18 is made form the same material as the two-layered electrode wiring line (connection electrode) 7a, a interlayer insulating film 10c is formed on the light shielding film 18, and a pixel electrode 8 is formed thereon.

[Effect]

Since a light shielding film 18 and a thin film transistor 4 are formed on the same substrate in a step for manufacturing the thin

film transistor 4, the light shielding film 18 that had been conventionally made larger in consideration for the alignment accuracy can be formed in minimum size.

[Scope of Claim]

[Claim 1]

A liquid crystal display device comprising: a first substrate in which thin film transistors are formed in a matrix form; and a second substrate in which a color filter and a opposed electrode are formed, wherein the first substrate and the second substrate are kept to be opposed each other, wherein a first interlayer insulating film is formed to cover the thin film transistor on the first substrate, wherein a signal line connected to a source of the thin film transistor on the first interlayer insulating film, wherein a second interlayer insulating film is formed to cover the signal line on the first interlayer insulating film, wherein a connection electrode that is connected to a drain of the thin film transistor to connect a pixel electrode and the drain and a light shielding film that is provided in a lattice shape are formed on the second interlayer insulating film, wherein a third interlayer insulating film covering the connection electrode and the light shielding film is formed thereon, and wherein the pixel electrode that is connected to the connection electrode is formed to overlap the light shielding film in a lattice shape and the periphery thereof on the third interlayer insulating film.

[Claim 2]

The liquid crystal display device according to claim 1, wherein the connection electrode and the light shielding film are

made form a metal film constituting aluminum as its main constituent.

[Claim 3]

The liquid crystal display device according to claim 2, wherein a barrier metal layer for preventing mutual response between the thin film transistor and the connection electrode is inserted therebetween.

[Claim 4]

The liquid crystal display device according to claim 1, wherein the connection electrode is made form a barrier metal layer and a thin metal film constituting aluminum as its main constituent formed thereon, and wherein the light shielding film is made from the barrier metal layer.

[Detailed Description of the Invention]

[0001]

[Field of the Industrial Application]

The present invention relates to a liquid crystal display device in which a liquid crystal is interposed by a substrate comprising a thin film transistor and a substrate comprising an opposed electrode.

[0002]

[Prior Art]

In recent years, a structure and a manufacturing method of a thin film transistor in which an amorphous silicon film or a polycrystalline silicon film is formed on an insulating substrate and such film is used as an active region have been developed. Further,

an active matrix liquid crystal display device and the like have been put into practical use.

[0003]

Since light is irradiated from the top surface or the back surface of a substrate and is controlled by a liquid crystal shutter, excessive light must be blocked as much as possible in a liquid crystal display device. One of the unnecessary light is incident light emitting into a thin film transistor and the other of which is light transmitting through an uncontrollable region. The former causes an operational defect of the thin film transistor, whereas the latter causes degradation of contrast. In order to prevent such excessive incident light form emitting into the liquid crystal display device, therefore, various methods have been conventionally researched and developed.

[0004]

A conventional liquid crystal display device will be described as follows. Concerning the conventional liquid crystal display device, Fig. 2A is a plane view showing a substrate on which a pixel transistor is formed, and Fig. 2B is a cross sectional view cutting along a line A-A of the liquid crystal display device in Fig. 2A. In Figs. 2A and 2B, reference numeral 1 denotes a signal line, 2 denotes a scanning line, 3 denotes a polycrystalline silicon film, 4 denotes a pixel transistor, 5 denotes a source of the pixel transistor 4 (connected to the signal line 1), 6 denotes a gate of the pixel transistor 4 (connected to the scanning line 2), 7 denotes a drain of the pixel transistor 4 (connected to a latter-described pixel electrode), 8 denotes a pixel electrode made from a transparent

conductive film, 9 denotes a first substrate, 10 denotes a interlayer insulating film, 11 denotes a second substrate, 12a denotes a light shielding film blocking light form the pixel transistor 4, 12b denotes a light shielding film blocking light form the periphery of the pixel electrode 8, 13 denotes a color filter, 14 denotes a filter protective film, 15 denotes a opposed electrode, and 16 denotes a liquid crystal. Note that orientation films formed over the top surfaces of the first substrate 9 and the second substrate 11, respectively, are not illustrated in Fig. 2B.

[0005]

As shown in Fig. 2B, a light shielding film blocking excessive incident light that passes through the pixel transistor 4 is made from an opaque film that is composed of a chromium evaporation film or a color filter 13 in which three-colored filters are laminated at a side of the second substrate 11.

[0006]

[Problem to be Solved by the Invention]

In such the aforementioned conventional structure, however, since the alignment accuracy must be taken into consideration when the positioning between the first substrate and the second substrate is carried out, the light shielding films 12a and 12b are formed to allow for a margin of dimension, therefore there is a problem in which a opening 17 is diminished in size.

[0007]

The present invention is to solve the above-mentioned conventional problems. The object of the present invention is to provide a liquid crystal display device in which the dimension of the

opening through which light transmits can be enlarged and alignment for sticking substrates can be easily carried out in comparison with the conventional one.

[0008]

[Means for Solving the Problem]

In order to accomplish the above-described problem, a liquid crystal display device of the present invention is composed of a structure in which a drain of a pixel transistor and a pixel electrode are connected to each other through a connection electrode and a light shielding film is made from the same material as the connection electrode.

[0009]

[Function]

By employing the structure, since the light shielding film is directly formed at the side of a substrate on which a pixel transistor is formed, the matching accuracy between the pixel transistor and the light shielding film can be enhanced and the condition of the alignment accuracy required in the substrates bonding process can be eased. As result, a pattern for the light shielding film that had been made larger than the required size in view of the alignment accuracy can be reduced in size, and the opening can be enlarged in size.

[0010]

[Embodiment]

An embodiment of the present invention will be described hereinafter with reference to the drawings.

[0011]

Fig. 1A is a plane view showing a liquid crystal display device according to this embodiment of the present invention and Fig. 1B is a cross sectional view cutting along a line A-A of the liquid crystal display device in Fig. 1A. In Figs. 1A and 1B, same reference symbols as Fig. 2B are used for the identical portions and therefore detailed description is omitted here. Incidentally, reference numeral 7a denotes a connection electrode that connects a drain 7 of a thin film transistor 4 and a pixel electrode 8, 10a denotes a first interlayer insulating film, 10b denotes a second interlayer insulating film, 10c denotes a third interlayer insulating film, and 18 denotes a light shielding film provided on a fist substrate 9.

[0012]

In this embodiment, a region sandwiched by arrows signifies light shielding films 18 and, as shown in Fig. 1a, the regions other than openings 17 are covered with the light shielding films 18. In the cross sectional structure of the regions as shown in Fig. 1B, a pixel transistor 4 is formed on the first substrate 9, and a signal line 1 that conducts to a source 5 of the thin film transistor 4 through contact holes of the first interlayer insulating film 10a is made from an evaporation film comprising aluminum as its main constituent. A second interlayer insulating film 10b and the connection electrode 7a that conducts to the drain 7 of the thin film transistor 4 through contact holes of the first interlayer insulating film 10a and the second interlayer insulating film 10b are formed thereon. Further, the light shielding film 18 is formed on the second interlayer insulating film 10b and the third interlayer insulating film 10c is formed thereon. The pixel electrode 8 is

formed on the third interlayer insulating film 10c and this pixel electrode 8 and the connection electrode 7a are connected to each other through contact holes that are provided on the third interlayer insulating film 10c. Incidentally, the pixel electrode 8 and the light shielding film 18 are partially overlapped each other.

[0013]

In this embodiment, the pixel transistor 4 and the pixel electrode 8 are connected to each other through a material such as the connection electrode 7a comprising aluminum as its main constituent. Meanwhile, the contact between the pixel electrode 8 and the drain 7 can be further stabilized by disposing a barrier metal layer that prevents mutual reaction between the connection electrode 7a and the drain 7 or between the connection electrode 7a and the pixel electrode 8. Although the light shielding film 18 and the connection electrode 7a are composed by the same material in this embodiment, the barrier metal layer inserted between the connection electrode 7a and the drain 7 or between the connection electrode 7a and the pixel electrode 8 may be made form an opaque metal material such as a silicide film composed of tungsten or titanium and a nitride film composed of titanium. Further, a overlapping structure of the barrier metal layer and the connection electrode 7a may also be employed.

[0014]

According to the aforementioned structure, since a light shielding film is not required at the side of the second substrate 11, the high-precision alignment between the light shielding film 18 and the pixel transistor 4 is dispensed with in this structure and

the form of the light shielding film 18 can be made smaller than that of the conventional structure. Accordingly, the openings 17 can be enlarged and the number of pixels can be increased in comparison with the conventional structure if only same magnitude of brightness as the conventional structure is required.

[0015]

[Effect of the Invention]

The present invention comprises a structure in which electrode wiring lines led out from a source and a drain of a thin film transistor are laminated to form a two-layered electrode wiring line, a light shielding film is made from the same material as the two-layered electrode wiring line, an interlayer insulating film is formed on the light shielding film, and a pixel electrode is formed thereon. Therefore, the alignment accuracy between the thin film transistor and the light shielding film is enhanced. According to the above-described structure, since the size of the light shielding film may be minimized without respect to the accuracy of the alignment, it is possible to accomplish an excellent liquid crystal display device comprising a large opening. According to such structure, furthermore, the liquid crystal display device can be miniaturized in comparison with the conventional one to increase the number of pixels.

[Brief Description of the Drawings]

Fig. 1A is a plane view showing a substrate on which a pixel transistor is formed according to a liquid crystal display device of an embodiment of the present invention;

Fig. 1B is a cross sectional view showing a cross section of the liquid crystal display device cutting along a line A-A in Fig. 1A;

Fig. 2A is a plane view showing a substrate on which pixel transistor is formed according to a liquid crystal display device of an embodiment of the invention; and

Fig. 2B is a cross sectional view of the liquid crystal display device cutting along a line A-A.

[Description of the Reference Symbols]

1: signal line

4: pixel transistor (thin film transistor)

5: source

7: drain

7a: connection electrode

8: pixel electrode

9: first substrate

10a: first interlayer insulating film

10b: second interlayer insulating film

10c: third interlayer insulating film

11: second substrate

13: color filter

15: opposed electrode

18: light shielding film

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